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Dear AAD Document Control:

Subject: Quarterly Progress Report for July 1 – September 30, 2005 – Field Testing of Activated Carbon Injection Options for Mercury Control at TXU's Big Brown Station
DOE NETL Cooperative Agreement No. DE-FC26-05NT42305
EERC Funds 9061 and 9062

Enclosed is the Energy & Environmental Research Center (EERC) Quarterly Progress Report/Annual Progress Report for the subject U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) project. We have included two hard copies and one electronic copy in Adobe Acrobat format, in accordance with our agreement.

If you have any questions or comments about this report, please feel free to contact me by phone at (701) 777-5268, by fax at (701) 777-5181, or by e-mail at jpavlish@undeerc.org.

Sincerely,

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FIELD TESTING OF ACTIVATED CARBON INJECTION OPTIONS FOR MERCURY CONTROL AT TXU'S BIG BROWN STATION

Quarterly Progress Report

(For the period July 1 – September 30, 2005)

Prepared for:

AAD Document Control

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EERC Funds 9061 and 9062
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FIELD TESTING OF ACTIVATED CARBON INJECTION OPTIONS FOR MERCURY CONTROL AT TXU'S BIG BROWN STATION

ABSTRACT

This project supports the objectives set forth by the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) to field-test mercury control technologies that may prove effective for Texas lignites. The project is being led by the Energy & Environmental Research Center, with a highly skilled team consisting of TXU Power, the Electric Power Research Institute (EPRI), ADA-ES, Inc., and the Babcock & Wilcox Company and the collective support of a consortium of utilities that combust lignite.

The primary objective of the project is to evaluate the long-term feasibility of using activated carbon injection (ACI) options to effectively reduce mercury emissions from Texas electric generation plants in which a blend of lignite and subbituminous coals is fired. Testing will be conducted on Unit 2 of TXU's Big Brown Steam Electric Station, which is located near Fairfield, Texas, and is composed of two identical 600-MW units, each equipped with two parallel sets of electrostatic precipitators (ESPs) and fabric filters (FFs); when these control technologies are coupled with ACI, the EPRI-patented technology is referred to as a TOXECON™ in the United States. One-quarter of Unit 2 will be tested, thus allowing ACI (and possible additives) to be tested with simultaneous comparison of untreated flue gas on another one-quarter of the unit.

In early 2006, team members will field-test several AC and AC-plus-additive options to determine performance relative to injection rates and mercury emission reductions, determine balance-of-plant (BOP) impacts, and gather data that will allow for a preliminary economic evaluation of the commercial application of the proposed technologies. The AC, treated AC, and additives will be injected between the ESP and the FF on Side B of Big Brown Unit 2 for a target mercury removal rate of $\geq 55\%$. Additional short-term parametric testing will be conducted to investigate the possibility of higher removal rates of up to 70%–80%, with sustained longer-term removal rates of $\geq 55\%$, which recent pilot-scale tests suggest are possible.

After testing is completed, a preliminary economic analysis will be performed using the test data to assess the cost of implementing TOXECON for Hg control using the most promising sorbent technology as identified in this project. This project will test the ability to substantially enhance the ability of AC sorbents to remove Hg from lignite combustion gases. Test results will serve as the basis for preliminary determination of commercial economics for Hg removal, quantification of the BOP impacts of the control technologies, and investigation of the commercialization potential, particularly for Texas lignite blends.

The results of this effort will be applicable to virtually all utilities burning lignite in the United States and Canada, but especially those burning Texas Basin lignite. The project is estimated to cost approximately \$2.2 million and is being funded under the DOE NETL project entitled "Large-Scale Mercury Control Technology Field Testing Program – Phase II."

TABLE OF CONTENTS

LIST OF FIGURES	ii
PROJECT DESCRIPTION.....	1
GOAL AND OBJECTIVES	2
APPROACH	2
PROGRESS SUMMARY – PREVIOUS QUARTERS	3
Task 1 – Testing and Sampling Activities at Big Brown.....	3
Task 2 – Site Planning, Reporting, and Management.....	3
Subtask 2.1 – Field Test Planning and Site Preparation.....	3
Subtask 2.2 – Program Planning and Management.....	4
ACCOMPLISHMENTS FOR THIS QUARTER.....	4
Task 1 – Testing and Sampling Activities at Big Brown.....	4
Task 2 – Site Planning, Reporting, and Management.....	5
Subtask 2.1 – Field Test Planning and Site Preparation.....	5
Subtask 2.2 – Program Planning and Management.....	5
PROJECT SCHEDULE.....	6
SUPPORTING COST DETAIL (INCLUDES COST SHARE)	8
PROJECT RECOGNITION	8
Print Media.....	8
Online Articles.....	9
REFERENCES	9

LIST OF FIGURES

1	TOXECON and ESP Hg removal vs. ACI rate for pilot- and full-scale tests	3
2	Planned schedule for testing TOXECON at TXU's Big Brown Station	7

FIELD TESTING OF ACTIVATED CARBON INJECTION OPTIONS FOR MERCURY CONTROL AT TXU'S BIG BROWN STATION

PROJECT DESCRIPTION

The Energy & Environmental Research Center (EERC), through a consortium-based effort, is working to resolve mercury (Hg) control issues facing utilities burning Gulf Coast (GC) lignite. The EERC team includes TXU Power, the Electric Power Research Institute (EPRI), ADA-ES, Inc., and the Babcock & Wilcox Company (B&W). This team is preparing to field-test sorbent-based technologies, including activated carbon injection (ACI), treated AC, and the use of additives to remove Hg from lignite blend combustion gases. Test results will determine performance and cost-effectiveness and should be applicable to virtually all utilities burning lignite in the United States and Canada, but especially to those burning GC lignite. The sorbent options proposed have been developed, tested, and have shown to be the most promising at the pilot scale. The project is being funded under the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) project entitled "Large-Scale Mercury Control Technology Field Testing Program – Phase II."

The lignite industry has been proactive in understanding mercury control mechanisms and identifying control options for mercury in lignite–lignite blend combustion flue gases. Over 3 years ago, the EERC and EPRI initiated a series of discussions on mercury control with utilities that burn Fort Union (North Dakota) and GC lignite, which represent most of the lignite used in North America. This project will address the specific needs and challenges to mercury control from GC lignite-fired power plants. Texas GC lignite, in particular, can emit relatively high levels of Hg, with up to 80% elemental mercury (Hg^0), and monthlong monitoring by the EERC has shown an unusually high degree of variability.¹ These characteristics, combined with low Cl levels in the flue gas, make control of mercury from plants burning Texas GC lignite perhaps the most difficult of any coal type burned within the United States.

ACI technologies have been shown to be the most viable commercial options for systems without SO_2 scrubbers, including those emitting high levels of Hg^0 . Lignites, because of their typically low Cl and high Ca contents, produce high levels of Hg^0 and have also shown low Hg–sorbent reactivity. Pilot-scale testing under a previous project at the EERC evaluated various ACI technologies on the lignite blend combusted at Big Brown, which showed that ACI can be effective at capturing moderate levels of Hg. In these same tests, sorbent modifications (treatments or additives) were shown to be more effective. Longer-term, large-scale testing and verification of these technologies will be conducted at TXU's Big Brown Station, which is equipped with a TOXECON™ configuration and burns a Texas GC lignite–Powder River Basin (PRB) blend, in order to evaluate the effectiveness and balance-of-plant (BOP) impacts at Big Brown.

GOAL AND OBJECTIVES

This project will evaluate the long-term feasibility of using ACI to effectively reduce mercury emissions from Texas electric generation plants in which a blend of lignite and subbituminous coals is fired. Testing will be conducted on Unit 2, Side B, of TXU's Big Brown Steam Electric Station, which is located near Fairfield, Texas, and comprises two identical 600-MW units, each equipped with two parallel sets of electrostatic precipitators (ESPs) and fabric filters (FFs); when these control technologies are coupled with ACI, the EPRI-patented technology is referred to as a TOXECON in the United States. Thus each set allows for injection of sorbent technologies with simultaneous comparison of untreated flue gas on the opposing set.

The overall goal of this project is to field-test and verify options that can be applied cost-effectively to reduce mercury emissions in plants using GC lignite fuels. The EERC team will test ACI technologies for plants equipped with ESPs combined with FFs and an EPRI-patented technology referred to as TOXECON. The specific objectives designed to meet the goals of the project include the following items:

- The project team will field-test several AC and AC-plus-additive options to determine performance relative to injection rates and mercury emission reductions for a target removal rate of $\geq 55\%$ relative to inlet values.
- Care will be taken to determine BOP impacts related to the use of these sorbent-based technologies.
- The project team will gather data that will allow for a preliminary economic assessment of the commercial application of the proposed technologies.

A preliminary economic analysis will be performed using the test data to assess the cost of implementing TOXECON for Hg control using the most promising sorbent technology as identified in this project. This project will test the ability to substantially enhance the ability of AC sorbents to remove Hg from lignite combustion gases and achieve a high level of cost-effective control for this challenging coal. These results will allow determination of commercial economics for Hg removal, quantification of the BOP impacts of the control technologies, and investigation of the commercialization potential, particularly for Texas lignite blends.

APPROACH

This project will field-test the effectiveness of various sorbent-based technologies for a lignite blend-fired TOXECON system. Nontreated AC, treated AC, and AC with additives will be injected between the ESP and the FF on Side B of Big Brown Unit 2 (one-fourth of the unit will be affected) for a target mercury removal rate of $\geq 55\%$. Additional short-term parametric testing will be conducted to investigate possible higher removal rates of up to 70%–80%, with sustained longer-term removal rates of $\geq 55\%$, which recent pilot-scale tests suggest is possible (see Figure 1).

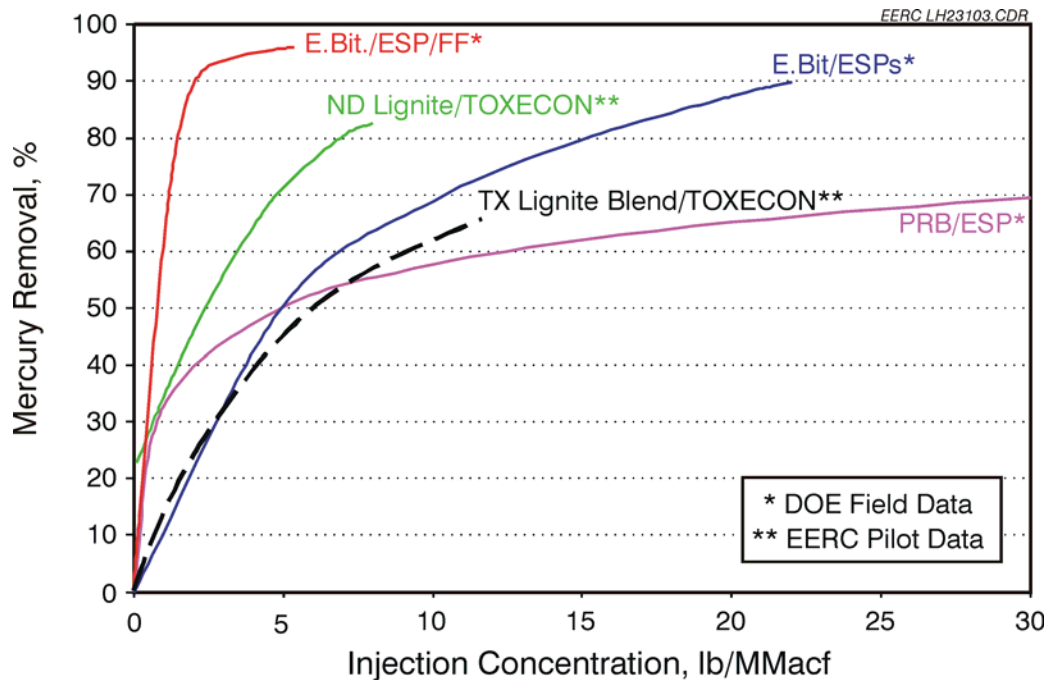


Figure 1. TOXECON and ESP Hg removal vs. ACI rate for pilot- and full-scale tests.

PROGRESS SUMMARY – PREVIOUS QUARTERS

This project was initiated early in 2005, with on-site testing scheduled to begin at Big Brown Unit 2 in January 2006. Activities for this project involve only one power plant and are structured in two concurrent tasks: Task 1 – Testing and Sampling Activities at Big Brown and Task 2 – Site Planning, Reporting, and Management.

Task 1 – Testing and Sampling Activities at Big Brown

Activities under this task will not begin until January 2006. Activities in support of this task are performed under Task 2, noted below, and will be completed in Budget Period 2.

Task 2 – Site Planning, Reporting, and Management

All of the activities conducted to date have been performed under this task.

Subtask 2.1 – Field Test Planning and Site Preparation

- Under previous quarters, the following work has been accomplished for this subtask:
- The work as originally proposed was scheduled for the last half of 2005 at Big Brown. To accommodate DOE funding, the project was rescheduled for the first half of 2006, with field activities slated to begin in January 2006.

- A joint decision was reached between the project team members to test one-quarter of Unit 2 instead of one-half the unit. This will result in less AC being used.
- The DOE kickoff meeting was held on April 19, 2005. The TXU project kickoff meeting was held at the Big Brown Station on May 18, 2005; this meeting was coupled with a site visit to make further plans regarding testing and equipment placement. Plans are progressing to accommodate a planned outage at Big Brown to begin October 15, 2005.
- The first two revisions of a site-specific test plan were submitted to DOE and TXU. Their comments were incorporated.
- Negotiations were undertaken with various equipment suppliers to find a company to fabricate the additive system.

Subtask 2.2 – Program Planning and Management

- Confidentiality agreements are in place with ADA-ES and B&W.
- The host site agreement was finalized with TXU.
- For this project, DOE NETL has approved a slightly decreased cost share because ADA-ES will no longer provide cost share related to the purchase of the additive system. This issue has been discussed with NETL, and approval was granted to continue.
- A continuation application was submitted to DOE in June for funding for Budget Period 2.

ACCOMPLISHMENTS FOR THIS QUARTER

Task 1 – Testing and Sampling Activities at Big Brown

Task 1 activities are related to on-site testing and sampling at Big Brown, all of which are scheduled to begin in January 2006. All field activities, including all testing and sampling activities related to this project, will be conducted under this task.

Besides field sampling activities, this task involves the processing of the data generated during this activity, including the comparison of test and plant operational data, data reduction, subjecting data to quality assurance/quality control (QA/QC) measures, and data analysis.

Task 2 – Site Planning, Reporting, and Management

Subtask 2.1 – Field Test Planning and Site Preparation

During this budget period, the EERC has had numerous interactions with sponsors and project participants who will assist the EERC to perform the work at Big Brown. To date, the EERC has accomplished the following work related to this subtask:

- On September 28, 2005, EERC Project Manager John Pavlish and Site Lead Jeff Thompson visited Big Brown Station to discuss the test plan, site needs, and permitting with TXU personnel. Key TXU attendees were Ron Pearce, Bob Wiemuth, and Paul Coon.
- In preparation for the on-site meeting, the EERC site needs were rigidly defined and compiled so they could be discussed with TXU personnel. The site needs included details such as the exact count and layout of EERC equipment, electrical/compressed air needs for all equipment and sampling locations, and installation details for the injection and sampling ports that will be added during Big Brown's outage, which begins October 15, 2005.
- A teleconference was held with Jean Bustard of ADA-ES on September 22, 2005, to discuss the operation of the COHPAC baghouse at Big Brown. Information regarding the operation of the baghouse and the effects of sorbent injection were discussed as they relate to the proposed test plan.
- TXU officials have reviewed the amended site-specific test plan (SSTP), and their comments have been incorporated. This test plan includes the planned test matrices, schedule of testing for the continuous mercury monitors (CMMs) and Ontario Hydro (OH) method samples, roles of the various project members, and details required to obtain data necessary to make comparisons to plant operating conditions. The SSTP will be finalized next quarter to include final comments.
- Technical details are being discussed with TXU and DOE to coordinate testing efforts between this project and a separate project involving the EERC's mobile slipstream baghouse unit, which will be operated concurrently with this project.

Work in this task is ongoing and will be completed in Budget Period 2.

Subtask 2.2 – Program Planning and Management

Numerous project-planning conference calls and meetings have been held to discuss the roles of the various project members; other activities are as follows:

- A confidentiality agreement was signed between the EERC and a vendor capable of supplying all of the proprietary additive (EERC SEA4) needed for testing, plus on-site storage options, injection equipment, and technical information regarding the handling and use of the additive.
- The additive vendor reviewed options regarding the injection equipment needed at Big Brown and indicated that a custom system was needed for this unique application. At our request, the vendor initiated the design of a custom injection system to meet the project needs. After several design iterations with the additive supplier and injection system manufacturer, a design was achieved that allows for flexibility of feed rate and short-term and long-term additive-feeding options. A supply date was confirmed by the equipment manufacturer, and the process to purchase the equipment was started.
- The host site agreement between the EERC and TXU was negotiated and finalized and has been submitted to the DOE Contracting Officer and Performance Monitor.
- The necessary permitting required for the on-site testing has been discussed and the application procedure started with TXU. For the permitting process to proceed, the EERC has supplied not-to-exceed estimates of emitted materials for the testing at Big Brown. TXU personnel are now in the process of filing the application.
- Agreements are being negotiated with ADA-ES, B&W, and EPRI and will be finalized next quarter.
- DOE indicated approval of the continuation application for Budget Period 2 and accelerated funding by providing \$200,000 in funding for Budget Period 1 and decreasing Budget Period 2 by the same amount.
- In order to get comparative data and to push the limits of operating parameters beyond those that Unit 2 can withstand, a separate project has been proposed and accepted by TXU and DOE (Joint Venture project, Task 93) to operate the EERC's slipstream baghouse unit concurrently with the large-scale AC project. Under this project, the same flue gas will be diverted through the mobile baghouse unit to obtain directly comparable results. The details of the coordination between the two projects are still being decided and will be finalized during the next quarter.

PROJECT SCHEDULE

Figure 2 shows a Gantt chart of the activities for this project.

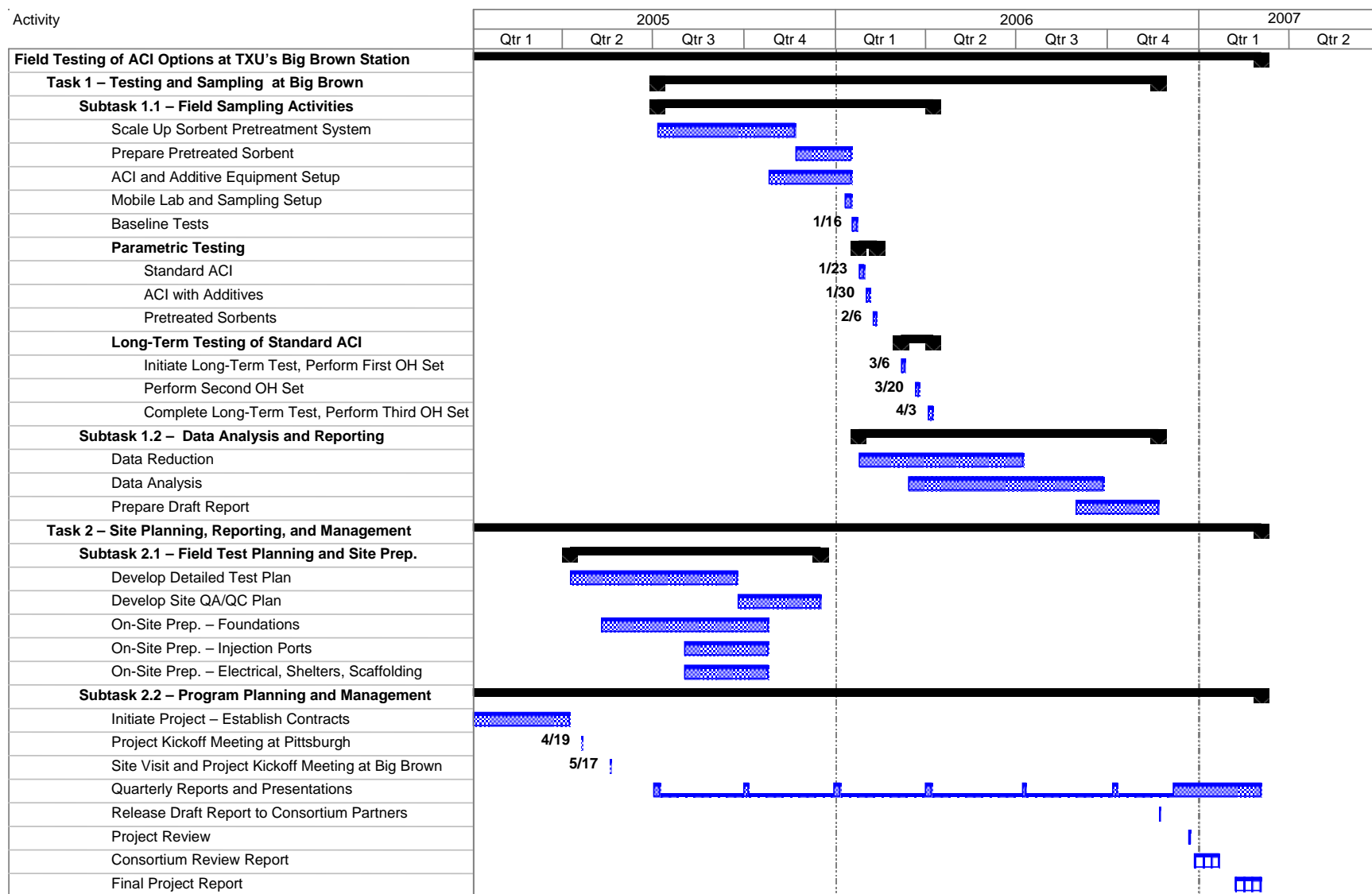


Figure 2. Planned schedule for testing TOXECON at TXU's Big Brown Station.

SUPPORTING COST DETAIL (INCLUDES COST SHARE)

Funding for Budget Period 2 was proposed at \$1,915,849. Of this amount, DOE's share was \$1,300,000. As indicated by the DOE Performance Monitor, DOE provided an additional \$200,000 in September, which will reduce the amount for Budget Period 2 by a corresponding amount.

As originally proposed, ADA-ES was to provide an additive system at a cost of \$135,601, with an additional \$54,750 of cost share provided, but this system will now be purchased from another supplier. \$188,000 was estimated for the AC and related shipping, with \$130,820 set aside as cost share, but the decision to inject AC into one-quarter of the unit versus one-half means that less carbon will be needed. These changes have resulted in a net change of cost share from \$190,570 to \$13,800 for ADA-ES. Although the in-kind cost share for this project has been decreased, it still exceeds the cost share called for in the solicitation. This issue has been discussed with NETL, and approval was granted to continue.

TXU's full cash cost share for this project has been secured in the amount of \$475,000. It has also committed to providing \$75,000 of in-kind contributions.

B&W will fund this project directly for \$25,000 of cash cost share instead of providing \$18,000 through EPRI's tailored collaboration program.

EPRI has indicated that it will still provide the \$30,000 of in-kind cost share that was committed to this project.

PROJECT RECOGNITION

The following items pertain to publications or press releases that are related to the project entitled "Field Testing of ACI Options for Mercury Control at TXU's Big Brown Station."

Print Media

- "UND Group to Lead Research on Lignite Electricity Plants," Valley City Times-Record, November 23, 2004.
- "UND Group to Lead Research on Plant," Jamestown Sun, November 23, 2004.
- "UND Group to Lead Research on Lignite Plant," Williston Herald, November 23, 2004.
- "Group to Research New Lignite Plant," Bismarck Tribune, November 24, 2004.
- "Trade Talk: UND Center Leads \$2.3 Million Project," Forum of Fargo-Moorhead, November 23, 2004.

- “UND Group to Lead Research on Lignite Plant,” Grand Forks Herald, November 23, 2004.

Online Articles

- “Removing Mercury from Lignite Burning Plants,” Waterfalls Institute of Technology Transfer (WITT) Technology Review, www.witts.org/env_audit_37_feb04/wista_eva_funding.htm (accessed Feb 2005).
- “UND group to lead research on lignite plant,” Energy Central Professional (accessed Nov 23, 2004).
- “EERC Selected to Lead a \$2.3 million Project in Mercury Control,” Power Engineering Magazine (accessed Nov 2004).
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- “UND group to lead research on lignite plant,” Associated Press (accessed Nov 2004).
- “EERC Awarded \$2.3 million Mercury Research Project,” ENN (accessed Nov 2004).
- “DOE Announces Further Field Testing of Advanced Mercury Control Technologies,” TECHnews from DOE NETL (accessed Nov 2004).

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1. Laudal D.L.; Roberson, R. *JV Task 42 – Longer-Term Testing of Continuous Mercury Monitors*; U.S. Department of Energy: Pittsburgh, PA, and EPRI: Palo Alto, CA, 2003.